ROYAL ASTRONOMICAL SOCIETY.

VOL. XVIII. *February* 12, 1858. No. 4.

THE Annual General Meeting of the Society, MANUEL J. JOHNSON, Esq., V.P., in the Chair.

Wm. Doeg, Esq., Carlisle;
Dr. Godfrey, Enfield; and
William Keith Murray, Esq., H.M. 60th Rifles,

were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-eighth Annual General Meeting of the Society.

The Council present their Report for the past year with congratulations on the state and prospects of the Society.

The Report of the Auditors, subjoined, will show the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	764	16	10
By dividend on £2878 17*s.* 5*d.* new 3 per Cents	40	6	1
By ditto on £1650 Consols	24	0	7
By ditto on £3500 new 3 per Cents	50	19	5
On account of arrears of contributions	163	6	0
111 contributions (1857–58)	233	2	0
7 compositions	147	0	0
Carried forward	£1423	10	11

	£	s.	d.
Brought forward	1423	10	11
19 admission-fees	39	18	0
16 first year's contributions	24	3	0
Sale of Publications	69	14	6
	£1557	6	5

EXPENDITURE.

				£	s.	d.
Salaries:—						
R. Grant, Esq., 1 year as Editor of the *Monthly Notices*	40	0	0			
Balance due for previous year	10	0	0			
Mr. Williams, 1 year as Assistant-Secretary	100	0	0			
Ditto commission on collecting £530 3*s.* 6*d.*	26	10	6			
				176	10	6
Investments:—						
Investing £621 2*s.* 7*d.* new 3 per cents				575	6	6
Taxes:—						
Land Tax, 1 year	5	7	6			
Income Tax, ditto	3	6	8			
				8	14	2
Bills:—						
G. Barclay, printer	115	7	10			
Ditto	158	18	4			
				274	6	2
J. Basire, engraver	18	18	0			
Ditto	12	6	6			
Ditto	12	11	3			
				43	15	9
L. Wyon, medals				57	15	0
J. Rumfit, bookbinder				15	14	7
D. Nutt, bookseller	7	19	6			
Sundry payments out of Turnor Fund	3	14	6			
				11	14	0
Miscellaneous items:—						
Charges on books, and carriage of parcels	4	15	2			
Postage of letters and *Monthly Notices*	26	17	0			
Porter's and charwoman's work	21	11	8			
Tea, sugar, biscuits, &c. for evening meetings	13	13	0			
Waiters attending meetings	3	17	0			
Coals, wood, &c.	12	0	0			
Sundry disbursements by the Treasurer	19	17	5			
				102	11	3
Balance at Banker's				290	18	6
				£1557	6	5

Assets and present property of the Society on Feb. 8, 1858:—

				£	s.	d.
Balance at Banker's				290	18	6
1 contribution of 3 years' standing	6	6	0			
11 ——— of 2 ditto	46	4	0			
27 ——— of 1 ditto	56	14	0			
Various sums on account of arrears	31	9	0			
				140	13	0
Due for publications of the Society				2	16	0
£1650 3 per Cent Consols.						
£3500 new 3 per Cents.						
Unsold publications of the Society.						
Various astronomical instruments, books, prints, &c.						
Balance of Turnor Fund (included in Treasurer's account)				32	2	11

Stock of volumes of the *Memoirs*:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	36	VIII.	199	XIX.	245
I. Part 2	79	IX.	204	XX.	234
II. Part 1	97	X.	216	XXI. Part 1 (separate).	321
II. Part 2	64	XI.	227	XXI. Part 2 (separate).	100
III. Part 1	122	XII.	234	XXI. (together).	147
III. Part 2	142	XIII.	252		
IV. Part 1	143	XIV.	439	XXII.	244
IV. Part 2	156	XV.	224	XXIII.	254
V.	170	XVI.	247	XXIV.	248
VI.	190	XVII.	228	XXV.	294
VII.	212	XVIII.	220		

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1857	152	188	51	5	396	53	449
Since elected	4	15	...	...	19	...	19
Deceased	−5	−6	−11	...	−22	−1	−23
Resigned	...	−7	...	...	−7	...	−7
Removals	4	−4	...	...	...	...	...
Expelled	...	−2	...	...	−2	...	−2
February 1858	155	184	40	5	384	52	436

The instruments belonging to the Society (exclusive of the Sheepshanks collection, presently announced as a recent donation) are now distributed as follows:—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Herschelian* 7-foot telescope,
The *Greig* universal instrument,
The *Smeaton* equatoreal,

The *Cavendish* apparatus,
The 7-foot Gregorian telescope (late Mr. Shearman's),
The Variation transit (late Mr. Shearman's),
The Universal quadrant by Abraham Sharp,
The *Fuller* theodolite,
The Standard scale,

are now in the apartments of the Society.

The remaining instruments are lent, during the pleasure of the Council, to the several parties under mentioned, viz.:—

The *Beaufoy* clock, to the Rev. J. B. Reade.

The *Wollaston* telescope, to the Rev. T. W. Webb.

The *Lee* circle, to Mr. Burr.

The other *Beaufoy* clock, and
The two invariable pendulums, together with
The Brass quadrant, said to have been *Lacaille's*,

reported for some years past as being in the possession of the Royal Society, cannot at present be found by that Society. Inquiry is, however, going on respecting them.

The collection of instruments presented by Miss Sheepshanks is also at the Apartments of the Society. The instruments have been marked and put in order, and are now ready for lending to the Fellows, under the usual regulations. The following is a list of them:—

1. 30-inch transit, by Simms, with level and two iron stands.
2. 6-inch transit theodolite, with circles divided on silver; reading microscopes, both for altitude and azimuth; cross and siding levels; magnetic needle; plumbline; portable clamping foot and tripod stand.
3. $4\frac{6}{10}$ achromatic telescope, about 5 feet 6 inches focal length finder, rack motion; double-image micrometer; object-glass micrometer; two other micrometers; one terrestrial and ten astronomical eyepieces, applied by means of two adapters.
4. $3\frac{1}{4}$-inch achromatic telescope, with equatoreal stand; double-image micrometer; one terrestrial and three astronomical eyepieces.
5. $2\frac{3}{4}$-inch achromatic telescope, with stand; one terrestrial and three astronomical eyepieces.
6. $2\frac{3}{4}$ achromatic telescope, about 30 inches focus; one terrestrial and four astronomical eyepieces.
7. 2-foot navy telescope.
8. 45-inch transit instrument, with iron stand, and also Y's for fixing to stone piers; two axis levels.
9. Repeating theodolite, by Ertel, with folding tripod stand.
10. 8-inch pillar-sextant, divided on platinum, with counterpoise stand and horizon roof.

11. Portable zenith instrument, with detached micrometer and eyepiece.
12. 18-inch Borda's repeating circle, by Troughton.
13. 8-inch vertical repeating circle, with diagonal telescope, by Troughton and Simms.
14. A set of surveying instruments, consisting of a 12-inch theodolite for horizontal angles only, with extra pair of parallel plates; tripod staff; in which the telescope tube is packed; repeating table; level collimator, with micrometer eyepiece; and Troughton's levelling staff.
15. Level collimator, plain diaphragm.
16. 10-inch reflecting circle, by Troughton, with counterpoise stand; artificial horizon, with metallic roof; two tripod stands, one with table for artificial horizon.
17. Hassler's reflecting circle, by Troughton, with counterpoise stand.
18. 6-inch reflecting circle, by Troughton, with two counterpoise stands, one with artificial horizon.
19. 5-inch reflecting circle, by Lenoir.
20. Reflecting circle, by Jecker, of Paris.
21. Box sextant and 3-inch plane artificial horizon.
22. Prismatic compass.
23. Mountain barometer.
24. Prismatic compass.
25. 5-inch compass.
26. Dipping needle.
27. Intensity needle.
28. Do. Do.
29. Box of magnetic apparatus.
30. Hassler's reflecting circle, with artificial horizon roof.
31. Box sextant and $2\frac{1}{4}$-inch glass plane artificial horizon.
32. Plane speculum artificial horizon and stand.
33. $2\frac{1}{2}$-inch circular level horizon, by Dollond.
34. Artificial horizon roof and trough.
35. Set of drawing instruments, consisting of 6-inch circular protractor; common ditto; 2-foot plotting scale; two beam compasses and small T square.
36. A pentagraph.
37. A noddy.
38. A small Galilean telescope, with the object lens of rock-crystal.
39. Six levels, various.
40. 18-inch celestial globe.
41. Varley stand for telescope.
42. Thermometer.

Two of them are lent as under :—

1. 30-inch transit instrument, to Mr. Lassell.
2. 6-inch theodolite, to Mr. De La Rue.

The following applications have also been granted:—

3. $4\frac{6}{10}$ achromatic telescope to Mr. Grant.
4. $3\frac{1}{4}$ Do. to Mr. De La Rue.
5. $2\frac{3}{4}$ Do. to Rev. S. W. Wand.
6. $2\frac{3}{4}$ Do. to Rev. J. Cape.
8. 45-inch transit instrument, to Professor Wheatstone.

The Council has had its attention called, by the united request of five of the Fellows, agreeably to the bye-laws, Section X, to the discussion of an alteration in, or rather an addition to, the mode of electing the Officers and Council. Owing to the lateness of the proposal, it has been necessary to refer the matter to the next Council. The addition proposed seems to arise out of the opinion that the present method, which consists in bringing to the vote a list prepared by the retiring Council, with individual liberty of substitution of any one name for any other, gives no opportunity of previous concert in the election of officers, except among those Fellows who happen to be thrown together by circumstances. It is accordingly desired that every Fellow should have a power of nomination, and that the nominations should be forwarded with the list proposed by the Council, in the manner now practised with that list alone. To the principle of this proposal there can hardly be an objection: and, provided that the Council are allowed to secure a working list, by actual ascertainment of those who are willing and able to attend, the production of additional names of other Fellows similarly circumstanced might be an additional advantage. But the new Council will probably hardly recommend a change, unless the feeling of the Society should appear in favour of it.

In the course of the last year, as the meeting is aware, the power given by the charter to have twelve Fellows on the Council was used, by the enactment of a bye-law increasing the number of the Council from ten to twelve. The Council accordingly, on the present occasion, propose to the meeting a list in accordance with the new bye-law.

The Council, during the course of the past year, had the pleasure of announcing to the Society the donation, by Miss Sheepshanks, of all the astronomical instruments left by her brother, the late Rev. Richard Sheepshanks. No proof was wanted, in this place, of the minute investigation which Mr. Sheepshanks had made of all classes of instruments: had it been, the number and value of the items of this collection would have been evidence of long and sustained attention. In recording this munificent present, and tending their warmest thanks to the donor, the Council express a firm expectation that the deposit of this collection in the hands of this Society, for the use of the Fellows, will promote, as no other disposition of them could have

promoted, that especial branch of astronomy to which Mr. Sheepshanks devoted his most marked attention. And looking at his unwearied exertions for our Institution, and the many years during which the astronomy here cultivated was his chief pursuit, and the astronomers here assembled his most familiar friends, the Council further feel almost entitled to assert, that no disposition of these instruments would have pleased him so well as that which the liberality of his sister has carried into effect. One of the instruments has already been lent by the Council for a most important purpose. A monument, with an inscription, surmounted with a bust, by Mr. Foley, R.A., has been placed in the chapel of Trinity College, Cambridge.

The Council have awarded the medal to the Rev. Robert Main, for his papers in the *Memoirs*, especially the series having relation to sidereal astronomy. The grounds of this award will be stated at the close of the meeting by our late President, Mr. Johnson.

The Society will remember that at the last annual meeting a discussion took place as to whether it would not be desirable to print the *Monthly Notices* in a quarto form, so as to enable them to be bound up with the *Memoirs;* and also as to the expediency of presenting the *Memoirs* gratis to those Fellows who should apply for them. Both subjects have been attentively considered since the period mentioned. With regard to the form of the *Monthly Notices*, there was a decided preponderance of opinion in favour of the octavo form, as more convenient for the sort of consultation which these *Notices* receive, and as more associated with the character of the ephemeral communications which they are intended to invite, in addition to those of a more elaborate character. At present, then, the Council do not recommend any change; but the subject is one which may be discussed again at any time. With respect to the gratuitous distribution of the *Memoirs*, it appeared, by careful estimates, that the expenditure of the Society at the present time comes so nearly up to its income, that the Council cannot venture to propose any change which would tend to diminish that income. It may confidently be hoped, however, that a very few years will make such a difference as will throw this ground of objection out of the question: and the Council will certainly not lose sight of the proposal, which is in itself a desirable measure.

The twenty-sixth volume of the *Memoirs* will be ready for publication in a few days, the insertion of a corrected list of the Fellows of the Society being all that remains to be done before putting the volume into the hands of the binder. Although the papers contained in this volume are not numerous, they are not deficient either in interest or importance.

Mr. W. H. Simms, besides contributing a paper on the correction of sextant observations for instrumental error, has, in a communication of much interest, investigated the corrections to be applied to observations made with a transit instrument placed in the prime vertical. A few years ago Mr. Simms supplied Mr. Hartnup with formulæ for that purpose, which were employed by the latter in determining the latitude of the Liverpool Observatory, from a series of observed transits of stars across the prime vertical. On the present occasion Mr. Simms has revised his previous investigation, giving the expression for deviation from the prime vertical a more convenient form, and taking into account the effect of error of collimation, which he had not considered in his original inquiry. The formulæ in their revised shape were applied anew by Mr. Hartnup to the determination of the latitude of the Liverpool Observatory, and a result was obtained, differing by $0''{\cdot}32$ from the value previously found.

Mr. Main has communicated a paper, the object of which is to investigate the degree of accuracy with which Bessel's Refraction Tables, given in the *Tabulæ Regiomontanæ*, represent the star-observations made at Greenwich. It is well known to the Fellows of the Society that this paper forms merely one of a series of valuable communications by Mr. Main, which have appeared in the volumes of our *Memoirs*, and the object of which has been the application of the modern Greenwich observations to the correction of the fundamental constants of astronomy. It is not necessary to make any further remarks on Mr. Main's labours in the present instance, as the acting President will have occasion to refer to them at the close of the proceedings.

The volume of the *Memoirs* concludes with an important paper by the Astronomer Royal on some ancient eclipses. In a paper, which he had communicated to the Royal Society a few years ago, he determined the date of the eclipse of Thales, using the eclipse of Agathocles as a cardinal point of reference for correcting the motions of the moon's node. Subsequently the researches of Mr. Adams, on the value of secular acceleration, and the publication of Professor Hansen's Solar and Lunar Tables, suggested to Mr. Airy the expediency of investigating the subject afresh; and he was further prompted to this step by the circumstance of his attention having been directed to another eclipse recorded by Xenophon as having occurred at the capture of Larissa by the Persians. Upon actual examination he found that the shadow of the last-mentioned eclipse was exceedingly narrow; and viewing this fact in connexion with the definiteness of the locality in which the eclipse occurred, he was induced to assume it as the cardinal eclipse of his researches. It was found that the Tables of Professor Hansen represent very well the phenomena of the three eclipses, indicating merely a slight increase of the acceleration and of the argument of latitude in distant ages. The only essential modification of his previous researches obtained by the Astronomer Royal con-

sisted in the necessity of assuming that Agathocles, upon quitting Syracuse, must have passed on the south side of Sicily.

The *Monthly Notices* continue to present the same features by which they have been characterised for several years past. The Council have, therefore, only to impress upon the Society the advantages which this periodical holds forth as an easily accessible channel of publication, and to invite the co-operation of cultivators of astronomy of all classes in contributing towards its support. In consequence of the gradual increase in the number of the Fellows of the Society, which has taken place during the last few years, and the applications which are being constantly made from foreign countries for the *Monthly Notices*, it has been found desirable to enlarge the impression a little. The slight addition to the expense of publication which has thus been incurred, will be amply compensated by the more general diffusion of this part of the Society's publications throughout the world. During the illness of the Editor, which lasted several months, the publication of the *Monthly Notices* was superintended in the first instance by a Committee, consisting of Mr. Carrington, Mr. De la Rue, and Mr. Main, and subsequently by Mr. Carrington alone. The Council feel assured that the Society will unite with them in awarding their cordial thanks to those gentlemen for their valuable services on that occasion.

The Council have to regret the loss by death of their Associate Sig. Antonio Colla, and of the following Fellows of the Society:—Dr. Bloxham; Admiral Sir F. Beaufort; Capt. Corry; Dr. Drew; Dr. Dick; Earl Fitzwilliam; Capt. Graham; Dr. King; Dr. Maddy; Admiral Owen; H. Perkins, Esq.; C. H. Wild, Esq.

Professor Antonio Colla, Director of the Observatory at Parma, and one of our Associates, died, after a few days' illness, on the 8th of March, 1857, at the age of fifty-one years. Having energetically devoted himself to Astronomy and Meteorology, he had raised the institution into such general esteem, that every scientific discovery throughout Europe was communicated to him; and his library was enriched with presentation-copies of the various scientific works. He was esteemed a patient and clever searcher after comets, and was honoured with one of the gold medals bestowed by the King of Denmark on the discoverers of those bodies.

In the death of Rear-Admiral Sir Francis Beaufort, K.C.B., D.C.L., we have to deplore the loss of an excellent officer, a warm advocate of science, an early friend of this Society, and an amiable member of the community. His health had been declining for the few last years, but his intellect continued clear and bright till his strength being finally exhausted, he expired, in the morning of the 17th of last December, rich in honours and ripe in age, in his eighty-

fourth year. This event occurred at Mills Terrace, Brighton; and the final duties were paid to his remains on the 22d, when they were deposited in the family vault at Hackney. In proof of his having retained his mental powers throughout, it may be recorded that only a few hours before he died, he held a disquisition with his doctor on the merits requisite for a good historian; and at ten the same evening, he asked his son, the Rev. D. A. Beaufort, to hand him Bishop Wilson's *Sacra Privata*, a book which he had constantly used since boyhood. At $1^h\ 50^m$, by a happy euthanasia, he breathed his last.

This officer was a son of the Rev. Daniel Augustus Beaufort, Rector of Navan and Vicar of Collon, an encouraging example of study and application, whose well-known map of Ireland was esteemed the best until the National Survey under the Ordnance took place; and the memoir which accompanied that map is still consulted as an authority. A predilection for maritime life having manifested itself, young Beaufort was sent to sea at an early age under the charge of the scientific Captain Lestock Wilson,—of the Hon. E. I. Company's service,—with a boy's rating. Under this intelligent officer he was drilled into nautical acquirements, and, having been already fairly educated, soon acquired them, insomuch that he was intrusted with the charge of the chronometers during most of the time he sailed with Capt. Wilson. At length, when that officer was proceeding to China in the Vansittart, in 1789, he received orders from the Company to examine the Macclesfield Strait for a shoal on which a valuable Indiaman had been lost. They sailed from Batavia on this service, and commenced operations by surveying Pulo Leat, an isle in the fairway of the Strait of Gaspar, the chart of which was entirely drawn by Beaufort. After an unsuccessful search for the reported danger from eleven established stations, Captain Wilson determined to resume his voyage; but on the evening of the 24th of August, the ship struck on the very reef they had been in search of, and was totally stranded. The officers and crew took to the boats and stood for Sangu Boolo, which, after four days of nearly starvation, they reached on the 29th, and were kindly received on board the ship Nonsuch, having had but one man drowned, and the boatswain and four seamen missing. As Malay pirates were prowling around, the Nonsuch and Elliot weighed the next day, and made sail for the wreck, which they found burnt nearly to the water's edge, and the sea making a fair breach over her; yet they recovered thirty-three chests of the Company's treasure, and some private property.

The fatigue and privations consequent on this disaster, weakened young Beaufort's attachment to sea-life; but on returning to Europe the excitement of public affairs fixed his mind, and he joined the Royal Navy. Having cruised in the Channel for some time, he was received on board the Aquilon, of 32 guns, commanded by the Hon. Robert Stopford, with whom he sailed to the Mediterranean to settle a commercial dispute with Morocco; and afterwards to

escort H.R.H. the late Duke of Sussex to Italy. This frigate had the good fortune to be one of Lord Howe's repeaters on the glorious 1st of June, of which great conflict our officer ever retained a vivid recollection. He soon afterwards accompanied his captain into the Phaeton, of 38 guns, and thus had the advantage of witnessing the masterly series of manœuvres now celebrated in history as Cornwallis's Retreat, by which a squadron of five sail-of-the-line and two frigates escaped from a powerful French fleet, in 1795. Subsequently the Phaeton drove on shore l'Echo, of 28 guns; and in company with the Anson captured La Daphne and La Flore, frigates, had a partial action with La Charente, 36, and took nine privateers and other prizes, besides assisting in the capture of La Bonne Citoyenne, corvette. This noviciate procured him a commission; and remaining in the same ship till October 1800, when he had become first-lieutenant, he won his further promotion to the rank of commander by gallantly boarding the San Josef, a Spanish polacca of 14 guns, and carrying her from under the fortress of Frangerola, near Malaga, where she was moored and flanked by a French privateer. In this signal exploit, the lieutenant received a severe wound in the head, and several slugs through his left arm and body, besides some which lodged, and occasioned great suffering. The prize, being a fine vessel, was immediately commissioned as an English sloop-of-war, under the name of Calpe. James, the naval historian, adds, "It would have gratified us to state that the officer, who as conductor of the enterprise had so gallantly and effectively co-operated, as well as so seriously suffered, in capturing the vessel, had been appointed to command her:" but Lord Keith chose to send a junior officer, who was an utter stranger to the capture, and the zealous captor was consigned to half-pay.

No sooner, however, had he regained strength, than the Commander gave gratuitously his valuable aid to his brother-in-law, Richard Lovell Edgeworth, Esq., in establishing a line of telegraphs from Dublin to Galway, for which, said Miss Edgeworth, "he would not accept any pecuniary remuneration, and devoted to this object two years of his life in unremitting exertion, both from private friendship, and from a belief that it would be beneficial to the country." Beaufort's sagacity was remarkable in every quarter to which it was directed; and the admirable communication which he made to Dr. Wollaston, respecting certain physiological phenomena which he experienced while under drowning sensations and suspended animation, is a striking instance in point.

One of the most busy and interesting periods of his service in the Phaeton, was her employment in concert with the left wing of the Austrian army under General Latterman, in 1800, not only during their advance along the coast from Genoa to Nice, but also during its retreat along the same road to rejoin Melas. In this Lieut. Beaufort was constantly occupied, day and night, in the boats or on shore; every day being in communication with the

Austrian head-quarters, and almost every day having some skirmish with the flank of the French army.

In the summer of 1805, Commander Beaufort was commissioned to the Woolwich, one of the old 44's on two decks, but *armée-en-flûte*. In this ship he proceeded to Bombay with naval stores; and in 1806 was intrusted, by Sir Edward Pellew, with a convoy of sixteen regular Indiamen, and some country-ships, for a passage home.* In 1807, he shared in the fatigue and vexation of the Rio de la Plata expedition, and his surveys of the banks and vicinity of Monte Video, though hasty, were eminently serviceable at the moment. His next appointment was to the Blossom, sloop-of-war, in June 1809, in which ship he was variously employed in protecting and convoying merchant-traders, till his preferment to post-rank in May 1810. On gaining this step he was nominated to the Frederickstein, one of the late Danish frigates; but he did not join her for some time, discharging meanwhile the duty of acting-captain of the Ville de Paris, of 110 guns, in the fleet off Toulon, commanded by his old friend Sir Edward Pellew.

Having joined his proper ship, he was directed, in 1811, to examine the coast of Karamania, on the southern shore of Asia Minor. This mission was ably executed, and about to be continued to Syria, when it was cut short in the summer of the following year by a treacherous attack of fanatic assassins, in which Captain Beaufort received a nearly fatal gun-shot wound in the groin. Thus incapacitated, the Frederickstein returned to England in company with the Rodney, 74, and was paid off in October 1812; since which he served no more afloat.

For several years after his return home, whenever the painful exfoliations of his last wound permitted, the Captain was busily employed in preparing his labours for publication. A mere surveyor would not have sufficed for the examination of those classical shores; and it is creditable to the Royal Navy, that it was able to furnish a gentleman capable of developing the maritime and antiquarian details of that interesting region. His charts are remarkable for precision and completeness, and his illustrative volume is at once sensible, instructive, and ably written. Indeed, considering the early age at which he went to sea, his attainments were remarkable, for he was a well-read scholar, an inquiring geologist, a tolerable artist, a sagacious critic, and an expert nautical astronomer; but for music he professed no passion.

After his admirable work was published, Capt. Beaufort remained unemployed for many years in London; but at length, in 1832, he was installed Hydrographer to the Admiralty, a post which assuredly required an able director, for nautical science had been obliged to force its way, even against official obstructions. At the time he took the scientific tiller in hand, progress was

* Admiral Smyth, referring to this convoy, mentions an interesting fact connected with one of the most valued supporters of our Society. In one of the ships of the convoy was Mr. De Morgan, then in his infancy, proceeding to England.—EDITOR.

making, though without a qualified head, as shown by the charts of the Mediterranean, coasts of Africa, Australia, Gulf of St. Lawrence, Lakes of Canada, West India Islands, shores of England, and the Polar explorations; and there were then afloat such men as White, Beechey, Graves, Bayfield, Owen, King, Hewett, Skyring, Wolfe, Belcher, Stanley, Spratt, Slater, Denham, Vidal, Forster, Mudge, Kendall, and others. Much, therefore, was expected from the known competence of the new leader; and truly he had a high and conscientious view of the duties of his useful and onerous post, regarding it as a trust for the advancement of nautical knowledge. This spirit led him on many occasions to kindly encourage and assist friendless merit; while few of our expeditions for discovery, research, or survey, were equipped without his aid and advice. But herein he had frequently to display self-command and endurance in no common degree; as, for instance, in the abrupt recall of Captain Graves—one of his most energetic and *producing* surveyors—without the supposed-responsible Hydrographer being even consulted; and an officer was despatched for the examination of New Zealand without his opinion being asked! Moreover, he was a Commissioner for Pilotage, and for Tidal Harbours and Ports of Refuge, and, therefore, had many calls, on matters extraneous from his legitimate occupations.

In 1845, Sir Francis accepted the rank of retired Rear-Admiral, and was permitted to retain his office. He had become a Fellow of the Royal, the Astronomical, and the Geographical Societies, and served occasionally in the Councils of each: he also gave his aid to the United Service Institution, and to the Society for the Diffusion of Useful Knowledge, for whom he undertook the cheap-map editorship. He held a seat at the Board of Visitors of the Royal Observatory at Greenwich, and the operations of the Royal Observatory at the Cape of Good Hope, were all reported to his office. He seldom missed attending to his daily duties, until he was turned of eighty years of age.

The Astronomer Royal bears his strong testimony to the uniform urbanity of Sir F. Beaufort to himself and his assistants, and to the uniform support given by him to the interests of the Royal Observatory, in all the transactions between the Admiralty and the Observatory, many of which passed officially through Sir F. Beaufort's department.

On coming ashore after quitting the Frederickstein, he married Alice Magdalena, eldest daughter of his early commander Captain Lestock Wilson, by which amiable lady he had issue three sons and three daughters. Some years after her lamented death, he married, secondly, Honoria, daughter, by a third marriage, of his brother-in-law, R. L. Edgeworth, Esq., of Edgeworth Town, in Ireland.

The Council are indebted for the foregoing details respecting the life and career of Admiral Beaufort, to their much-esteemed colleague, Admiral Smyth, whose acquaintance with the deceased extended over the long period of fifty years. In 1806 the gallant biographer of the deceased was on board the Woolwich, while

stationed at Bombay; and he was in the Rodney, when in 1812 that ship returned to England in company with the Frederickstein.

John Drew was born at Bower Chalk, in Wiltshire, in 1809. Having lost his father when a year old, he was, in consequence, obliged to depend upon his own unaided exertions for the acquisition of all but the merest rudiments of education; he began the profession which he followed through the whole of his life—that of teaching—at the early age of fifteen, as an assistant in a school at Melksham; two years later he settled in Southampton, where he resided for eight-and-twenty years, during the last sixteen of which he conducted a school with great ability and success.

He first made himself acquainted with the more accessible phenomena of the heavens by means of a $3\frac{1}{2}$-foot refractor, but he afterwards used a good 5-foot achromatic, the property of the late Rev. E. Dewdney, of Portsea, for the reception of which, in 1847, he built a small observatory, and mounted the telescope on a polar axis, and soon afterwards added a fine transit-circle, with which, aided by the Beaufoy clock (lent him during many years by the Royal Astronomical Society), he determined the time with great accuracy, and communicated it to the ships leaving the port of Southampton. He was elected a Fellow of the Royal Astronomical Society in 1846, and he communicated several papers on the details of instrumental adjustment and on other subjects; besides these, he wrote an introductory Manual of Astronomy; and later, a Treatise on Practical Meteorology, "the result of seven years' experience as an observer and student." His last work, completed a few weeks only before his death, was a set of astronomical diagrams, one of a series published under the Department of Science and Art, in which the heavenly bodies are strikingly and faithfully depicted. He died after a long illness on the 17th of December last, at Surbiton, Surrey, aged forty-eight.

Dr. Dick was born in 1772, and died at the age of eighty-three. The Council have not been able to procure any details of his life. He published various works on general science and natural theology, of which "Celestial Scenery," and "The Christian Philosopher," are well known. He was originally intended for a minister of the Scotch Secession Church, but it does not appear that he actually entered the ministry. In his latter years he had a pension from the Queen.

Dr. Joshua King was born January 16th, 1798, at Lowick, near Ulverstone, where his father was a miller and a small landed proprietor, or *statesman*. After leaving the Hawkshead Grammar School, he received some instruction in mathematics from the blind mathematician, Gough, of Kendal, and proceeded to Trinity College, Cambridge, in 1815, from which the next year he migrated to Queen's College. He was the Senior Wrangler of 1819, taking the degree with such unusual distinction that the Moderators drew several lines between his name and that of his follower in

the list. From hence arose a tradition among undergraduates that there is a mode of gaining the senior wranglership very rarely attained which gives statutable superiority and the name of *incomparabilis:* but we cannot find, on inquiry, that this is anything but a consequence of the discretion taken by the Moderators of 1819. Mr. King became Fellow and Tutor of his College, and in 1832 President,—a royal dispensation having been obtained to dispense with ordination. From 1839 to 1849 he held the office of Lucasian Professor. In the year in which he was elected President, he had a slight stroke of paralysis, from which he recovered; but a more severe attack in 1843 laid him up until his death, which took place September 1, 1857.

Dr. King had mathematical abilities of the first order: but his inclination turned rather towards law and politics than towards science. With the exception of a short paper in Vol. ii. of the *Cambridge Transactions*, he published nothing whatever. Dry questions of legal principle delighted him more than anything else. He personally defended the rights of the Fellows of his College in the Court of Chancery before Lord Lyndhurst; and we may add, that, as Vice-chancellor, he personally defended the Anatomical School and Museum at the head of a body of Graduates and Under-graduates, against the attack of a mob, exasperated by some rumours on the mode of obtaining subjects for dissection. It was chiefly by his appearance in the schools, as Moderator, that he could be known in his best days by those who were not privately acquainted with him. He was deeply acquainted both with the older mathematics and the modern analysis. He was most intimately acquainted with the *Principia*, and with the writings of Lagrange: and for many years after his degree a splendid career of investigation was looked for as a part of his future life. But his time was otherwise occupied. That he did not proceed to the bar probably arose from a love of retired study: and to the same cause must be attributed his refusal of two applications to enter the House of Commons, one from the University and one from the town.

The Rev. Watkin Maddy was probably a native of Herefordshire; he was of St. John's College, Cambridge, and was the Second Wrangler of 1820. He lived for some years on a Fellowship, and received the office of Moderator. He also entered into orders. More than twenty years ago he abandoned his fellowship, left Cambridge, and supported himself by teaching mathematics in London. The cause of this step was a scruple of conscience of an unusual character. He feared that he had taken orders only to preserve his fellowship, and he therefore determined to resign what he believed to be his ill-gotten gain. To others, in all probability, the mere fact of his being able to take such a step, to the loss of all fixed means of subsistence, would be presumption almost amounting to proof that the imagined motive had never existed.

Mr. Maddy was the author of an excellent work on astronomy,

showing full acquaintance with foreign writers, published in 1826. The copyright was purchased by Dr. Hymers, who enlarged it, and published it so enlarged in 1840. Mr. Maddy died in the last autumn, leaving behind him a character of the highest stamp.

Mr. Charles Heard Wild, Civil Engineer, was a pupil of Mr. John Braithwaite, and was considered by his professional brethren as a young engineer of great promise. At a very early age he was intrusted with the superintendence of the construction of Ericcson's propeller boats. He was afterwards placed at the head of Messrs. Fox, Henderson, and Co.'s drawing-office, in which he displayed such a remarkable aptitude for engineering science, that he was engaged by Mr. Robert Stephenson as one of his principal assistants on several works of magnitude, and among others the Britannia Bridge, where he largely assisted in devising and carrying out the floating of the tubes. He was afterwards appointed assistant-engineer, under Sir William Cubitt, to the Exhibition Building in Hyde Park; and on the formation of the Crystal Palace Company, was appointed engineer to the building at Sydenham, which was erected under his superintendence. About this time the painful disease, which terminated fatally, first manifested itself. He died on the 19th July, 1857.

Mr. Wild was the author of several valuable improvements in railways. His railway switch is now generally adopted, and his hexagon turn-table and dock-gates are also much esteemed. He was the author of a very valuable paper on "The Deflection and Relative Strains in single and continuous Beams," published in Mr. Edwin Clarke's work on the Britannia and Conway Tubular Bridges.

The Council have much regret in announcing that Professor Narrien retires at once from the Society and from his post at the Military College at Sandhurst, on account of the failure of his sight. Mr. Narrien's work on the "Origin and Progress of Astronomy" is one of the most valuable pieces of ancient history which has ever been written, and presents the results of deep learning to the student who possesses the mere rudiments, without any repulsive show of erudition. There is no work so easy and so accessible out of which to lay the foundation of a sound knowledge of early astronomical history: and it leaves off nearly at the point where Mr. Grant's modern history commences. The English student of the present day is fortunate in the means which he possesses of reviewing the progress of astronomy.

In the actual operations of the Royal Observatory during the past year nothing has occurred which requires much notice. The ordinary work of observations, and reduction of observations, has been pursued with the same undeviating regularity as heretofore, and the labours of the computers have so well kept pace with those of the observers that there are literally no arrears of reduction in any one department.

The volume of Observations for 1856 is completely printed, and is only waiting for the plates accompanying the description of the galvanic chronographic apparatus, to be put into the hands of the binder. The printing of the volume for 1857 is proceeding vigorously.

With the reflex zenith tube no further difficulty is experienced; and observations are made of γ *Draconis* at its transit over the meridian at whatever time of the day or night the passage occurs.

The revision and discussion of the reductions of the Greenwich lunar observations from the year 1830 to 1853, which were commenced in the early part of the year 1856, are nearly completed. The computers are at present engaged in the formation of the equations for the correction of the elements of the lunar orbit, and the printing of the results will afterwards be proceeded with.

The observations of the numerous small planets between the orbits of *Mars* and *Jupiter* are made with all possible regularity, all for which Ephemerides are found being searched for at the meridian passage. On account, however, of the exceeding faintness of many of them, and of the errors of the tabular places, comparatively few of the objects observed are found ultimately to be identical with the planets sought for, so as to repay the great amount of labour expended on them.

The only addition which has been made to the galvanic arrangements for the transmission of time, is that four clocks, belonging to the General Post Office in London, are now regulated at noon of each day by means of the current sent from Greenwich. Of these clocks, one, a galvanic clock, is in the office in Lombard Street, and acts as the normal clock at that office for regulating all the other clocks, and the remaining three are in the chief office at St. Martin's-le-Grand. The three latter clocks are ordinary weight clocks, and each of them is placed, by means of a battery and a system of wires, in communication with a distinct set of other clocks. The whole system of clocks is thus regulated at the same instant by the galvanic currents sent from Greenwich at noon.

The dropping of the time-signal balls in the Strand and at Deal, the regulation of the great clock at London Bridge, and the transmission of time-signals to different stations along the line of the South Eastern railway, are carried on with as little difficulty and interruption as can be expected in matters necessarily liable to so many causes of failure. The instances of failure are most frequent in the drop of the Deal ball; but these instances do not occur very often, and all pains are taken on every such occasion to discover and remedy the defect.

An attempt was made in the last week of November, 1857, to obtain the longitude of the Observatory of Edinburgh by galvanic star-signals registered simultaneously at both observatories. Nothing could exceed the excellence of the arrangements within the two observatories for the simultaneous register of the transits of the stars on the recording apparatuses of both, as they passed the

meridians of Greenwich and Edinburgh; but the whole of the operations were rendered almost nugatory by the imperfect insulation of a part of the wire employed, lying between the Admiralty and Blackheath, over which the Astronomer Royal had no control. The employment of that wire was rendered necessary on account of the known imperfection of the ordinary Lothbury wire, which it is found impracticable to rectify at present; and it was only after repeated failures of communication during the experiments for longitude, that the defect in the wire employed was recognised. A few corresponding observations were registered, and the satisfactory nature of the results deduced from them makes the failure of the communications the more to be regretted, though it gives assurance of the excellence of the method employed and of future success at the next trial that may be made.

The most important circumstance, however, in the history of the Royal Observatory for the last year, is the progress made in the preparation for mounting the great telescope, of which mention was made in the last Annual Report of the Council of the Society. The building is now completely finished; the heavy cast-iron support, for the upper and lower pivots of the polar axis, having been properly placed on the piers erected for them, during its progress. The casts and the engineer's work for the various parts of the mounting are proceeding in the establishment of Messrs. Ransomes and Sims, at Ipswich, with all practicable speed. The large object-glass was received from Messrs. Merz, in August last, and has since been severely tested by the Astronomer Royal, who is quite satisfied with its performance.

We may congratulate the Observatory on this immense addition to its instrumental means, and we may expect, through the able and prudent use which will undoubtedly be made of it by the Astronomer Royal, a still more brilliant career for the future to add to the renown of the Institution over which he presides.

The Catalogue of remarkable objects continues to be the principal work at the Radcliffe Observatory, and during the past year considerable progress has been made in it.

It was mentioned in last year's Report that the Groombridge papers had been placed in Mr. Johnson's hands for the purpose of ascertaining the mean dates of the observations on which Groombridge's places depend. This has been done, and the whole of Groombridge's Catalogue has been brought up to the year 1845. The Radcliffe Circumpolar Catalogue is therefore now complete; and the printing will be commenced as soon as there is an opportunity of doing so without interfering with the course of the annual publication of the Observatory.

Within the last few weeks the electro-chronographic system of recording transit observations has been put into practice. The apparatus, made by Mr. Dent, is similar to that which has been some time in use at the Royal Observatory. It is connected with

the station of the Electric Telegraph Company by means of a wire laid down some years ago.

In addition to its astronomical functions, the constant registration of the principal meteorological elements, by means of photography, has become part of the duties of this establishment. The indications of the barometer, of the dry- and wet-bulb thermometers, the direction and force of the wind are continuously recorded by this means; and an apartment has recently been erected on the tower of the Observatory, where the phenomena of atmospheric electricity will be noted by the same agency.

The inauguration of a new system is generally beset with difficulties, some foreseen, some unforeseen. Nor has this been an exceptional case. Failures and disappointments have been encountered, partly due to the photographic process, partly to the structure of the instruments. The imperfections, however, have for the most part been detected and remedied; and after some experience, Mr. Johnson feels justified in affirming that no system of continuous registration, with which he is acquainted, is more certain in its action, more economical in regard to labour and time, or more unerring in its indications;—certainly none so complete in its results.

The whole work of preparing the paper, reading and recording the results for twelve periods of the day, and arranging them for publication, and of making occasional observations daily of the ordinary instruments, which it is considered prudent to do by way of check, is performed by a single assistant, and he not unduly tasked.

At Cambridge, the publication of the Report of the Observatory Syndicate, in May last, shows the usual evidence of untiring work and steady progress.

The meridian observations of stars are now almost restricted to those that have been employed as comparison stars in the equatoreal observations of planets and comets.

Some steps have been taken towards a systematic reduction and arrangement for publication, of the equatoreal observations of past years, many of which have been reduced and published for occasional and immediate use.

Equatoreal and meridian observations of the eight minor planets selected for especial attention at this observatory have been successfully carried on in addition to meridian observations of some of the others. The planet *Leucothea* could not be seen last year, from being faint and low, but in October this year Mr. Breen succeeded in detecting it, and obtained several positions. The next reduction of the equatoreal observations of the minor planets and comets is kept up for the purpose of communicating the results to astronomers who may have occasion for them, although the publication of the details of the reductions in the Cambridge series of observations is unavoidably delayed.

Volume xviii. of the *Cambridge Observations* was published

at the end of last year. It contains the meridian observations of 1849, 1850, and 1851, and involved a heavy amount of calculation, all the observed places of the sun and moon, and of the minor planets, being compared with theoretical places, which, for these planets, had to be computed in many instances from the elements of their orbits.

The attention given in past years to means of correcting the errors of the transit and mural circle, arising from the wear and flexure of the material, was continued last year.

The Observatory being furnished with two Dollond telescopes on tripod stands, one of them has recently been mounted on an equatoreal stand out-of-doors, to be used for sweeping.

In the course of the last year, the eleventh volume of *Observations of the Edinburgh Observatory* has been published, bringing down the printed work to the end of 1854. A considerable quantity of material has been accumulated for another volume, and progress has been made with the preparation of a Catalogue from the earlier years of the establishment.

During the autumn, through the obliging intervention of the Electric Telegraph Company,—most liberal in the loan of their wires, and skilled assistants in any case for the promotion of science,—a series of observations for longitude was carried on by concert with the Astronomer Royal, between Greenwich and Edinburgh; the electric communication being complete between the two transit-rooms, and the observations of either place electrically printed at the other. An accidental leak, caused in an underground wire by a flash of lightning conducted from an exposed part of the line, prevented the observations being so successful as they should have been, but did not prevent the admirable accuracy of the American longitude plan being fully manifested; for a series of the observations presented differences of only as many hundredths of a second, as the earlier longitude determinations of Edinburgh had shown of full seconds. Nevertheless, it was extremely satisfactory to the memory of the late Professor Henderson, to find that he had made such excellent use of the comparatively imperfect methods of his day, as in his last determination, of $12^h\ 43^s{\cdot}0$, to have approximated to within a tenth of a second of what, for practical purposes, we may call the truth.

The reductions of Teneriffe Observations have also formed part of the occupation at Edinburgh during the past year. The first portions, chiefly astronomical, were presented to the Admiralty in February last; the remainder, physical and meteorological, in the month of May; and being communicated by that Department to the Royal Society, on June 2d, with a proposal for their being printed in the *Philosophical Transactions*, were submitted in the usual way to referees for a Report.

Being already aware that the proceedings of 1856 were but a beginning, merely a first experiment under circumstances pre-

viously unknown, and that they were found on the whole eminently favourable to further research, we might almost have expected that a more exactly and suitably organised expedition should have been sent out in 1857; but with a prudence that cannot be objected to, and a deference to the opinion of scientific men that deserves every commendation, the Admiralty and its advisers appear to have decided to take no further steps until there has been some public expression of feeling by learned men on the published results of 1856. Except that the last summer, so remarkably fine in this country, is reported from Teneriffe to have been there anomalously cloudless, and therefore capable of having afforded on the slopes of the mountain a greater hypsometric range of scale for actinometric and other investigations, than ordinary years,—it is believed that no harm can have occurred from the reasonable delay thus exercised. Meanwhile, we can state, that whatever else may appear from the printed Teneriffe Observations of 1856, now soon to be expected at the hands of the Royal Society, there will be most complete confirmation of an almost prophetic remark by Newton in 1730 (see his *Optics*), viz. that although "they (telescopes) cannot be so formed as to take away that confusion of rays, which arises from the tremors of the atmosphere;" yet there is a remedy, and only one,—"*a most serene and quiet air, such as may perhaps be found on the tops of the highest mountains above the grosser clouds.*"

During the time that the question of printing his observations, or the scientific part of the Teneriffe report, has been under consideration, Professor Piazzi Smyth was urged by several friends to publish some of the unscientific part of his journal, or an account of ordinary daily experiences when at a height of more than two miles in the atmosphere, in order that all men might judge of the general practicability of this mountain method of eliminating the lower third part of the atmosphere from any observations which they might wish to carry on themselves, under circumstances so different from their usual ones. This popular exposition, not being deemed suitable to the Government publication, the author, after preparing the manuscript, was thrown on his own resources; but happily, met before long with a spirited publisher as well as a man of science, in Mr. Lovell Reeve, who thought the subject so interesting, if not important, that he at once undertook the whole expense of printing—and even of illustrating with photo-stereographs—a method of illustration never attempted before, but invaluable to any faithful record of travels, and strikingly applicable to that most moon-like region of the craters and lava-streams of Teneriffe, situated above the level of Newton's "*grosser clouds.*"

The book in question has been published within the last few days, under the title of *Teneriffe, an Astronomer's Experiment; or, Specialities of a Residence above the Clouds.*

By an act of Parliament, passed during the last session, the Liverpool Observatory was, on the 1st of January, transferred from the Corporation to the "Mersey Docks and Harbour Board."

The duties of the Observatory, during the past year, have for the most part been confined to the testing of instruments for mariners, and to the reduction of observations taken with the self-registering anemometer. A few observations have, however, been taken of the most recently discovered comets, which are now being reduced, and Mr. Hartnup hopes that arrangements will shortly be made, which will enable him to pay more attention to equatoreal observations. The number of chronometers on hand during the past year has ranged from 100 to 140, and the time often allowed for testing does not exceed ten days or a fortnight. With accurate time, careful comparisons, and the good arrangements at the Liverpool Observatory for changing the temperature, it is found to be practicable to show the quality of a chronometer in a very short period, by the variation in the daily rate. The importance of this to mariners is beginning to be so well appreciated, that a large number of those who now visit the port will not purchase a chronometer without having it tested; and in consequence of this the makers keep a stock at the Observatory in order that their performances may be appealed to when required.

In December last Her Majesty, having resolved to present a marine chronometer to His Royal Highness Prince Alfred, directed inquiries to be made in order to obtain the best instrument for that purpose. The method of testing chronometers having been explained to His Royal Highness the Prince Consort, he resolved that one should be selected from the Liverpool Observatory, solely on account of its performance, without regard to the maker's name. An agent was accordingly sent to the Observatory, who made the selection from fifty-five new chronometers, by various makers. Some idea may be formed of the service rendered to navigation by this establishment, from the fact that from twenty to thirty per cent of the new chronometers sent there for trial previous to purchase, are often found to be in the hands of the makers for examination and alteration in the adjustments, shown by the test applied to be necessary; and it is exceedingly gratifying to witness the improvements in the performance of chronometers brought about by this arrangement.

Mr. Hartnup reports that the old turret clock on the top of the Town Hall, about a mile distant from the Observatory, still continues to strike with as much accuracy, and much more certainty, than it is possible to drop a time-ball. The pendulum of this clock is *controlled* by the normal clock at the Observatory.

The Fellows of the Society will have learned from the *Monthly Notices*, that Mr. Lassell is engaged in constructing a reflecting

telescope of still larger dimensions than the one which he has already employed so successfully in exploring the heavens.

Mr. Lassell has informed the Council that although many parts of the instrument and of the apparatus necessary for its construction are in some state of forwardness, very little is as yet completed. A very important step however, the casting of the great speculum, has been most successfully accomplished. Mr. Lassell has never seen a speculum, even of small dimensions, more perfect in every respect. Its dimensions are—diameter exactly 4 feet, thickness $4\frac{6}{10}$ inches. The face and back are respectively concave and convex portions of a sphere of about 76 feet radius; and in the back are very symmetrically cast thirty-eight recesses for the insertion of the ends of as many levers, for the prevention of flexure at low and moderate altitudes. The grinding is not yet begun; but the machine on which the process is to be conducted is nearly ready; and while that somewhat tedious operation is performing, Mr. Lassell purposes to proceed with the mounting, the arrangements for which are considerably advanced.

From Mr. Maclear, at the Cape of Good Hope, has been received a printed quarto, forming Part 3 of the *Remeasurement and Extension of La Caille's Arc of the Meridian*; not only most valuable in itself, as containing numerous particulars relative to the first-rate base-line measured there, but as indicating the course of his proceedings and the occupation of the Observatory.

Somewhat oppressed at first with the cares of erecting the grand Transit-Circle on the Greenwich model, liberally furnished him by the Admiralty, and of remodelling the Observatory building suitably, a work of no small anxiety in a country where neither contractors nor overseers are to be found,—but still convinced that meridian observations of sun, moon, planets, and principal stars, must form the chief work of the Observatory of the South,—Mr. Maclear gave his whole attention to this department, until daily and nightly observations with the new instrument were in satisfactory train of prosecution.

Meanwhile the approach to completion of the Russian geodetic operations, having rendered desirable an early publication of the South-African Arc, Mr. Maclear turned his attention to it when freed from the other more professional work; and the quarto above mentioned is the first-fruit of his comparative leisure. It contains, as we have already said, an account of the base-line measured on Zwartland plain in 1841 with Colby's "Compensation" bars: and no one will think 130 closely printed pages too much for the subject, when informed that, owing to difficult local circumstances, this is the only measured base for the whole arc, not only a great extension of La Caille's famous, yet anomalous measure, but intended to subserve the nice purpose of mountain attraction, as exerted by Table Mountain,—a most appropriate mass, both as regards its size and the regularity of its

composition. Full and minute particulars are given of a testing of the base by triangulation, resulting in the small probable error of ·41 inch for the whole length of 8·1 miles.

The next volume is stated to be already commenced, and contains the observations of the great triangulation, conducted chiefly with the Fuller theodolite, belonging to our Society, and lent to Mr. Maclear for that purpose.

Some length of time has elapsed since the observations were made; but the Base-Line memoir, now in our hands, assures us that not a shred will be lost.

The Transit-Circle for the Madras Observatory was sent out from England in the course of last autumn, and but for the exigencies caused by the Indian Mutiny would, in all probability, have been by this time in full operation. Meanwhile Capt. Jacob has not been idle, having executed, during the past year, a series of valuable equatoreal observations, chiefly of the satellites of *Jupiter* and *Saturn*. From his measures of the satellites of *Saturn* he has deduced corrected values of their elements; and it is interesting to remark the close accordance which subsists in most respects between his determination of the elements of *Japetus*, and the corresponding results which Mr. De la Rue obtained a few years ago by a purely graphic process. Capt. Jacob's measures of the satellites of *Jupiter* were executed chiefly with the view of ascertaining the amount of the probable error of his observations of the Saturnian system; but he has also been enabled by a discussion of the results to determine the mass of the planet, and has obtained a value which is almost identical with that to which the Astronomer Royal was conducted by his researches on the subject a good many years ago. The Society will regret to learn that, in consequence of ill-health, Capt. Jacob, it is feared, will shortly be compelled to return to England.

Mr. Carrington's time during the past year has been principally engaged in the completion of the reduction of his meridian observations of Northern Circumpolar Stars, in the arrangement of the whole for the press, with prefatory explanation, and necessary tables, engraving the charts intended to accompany the work, and in arranging the due circulation of his Redhill Catalogue when printed. A delay of a few weeks occurred during the official consideration of his application to the Admiralty for assistance in the printing, which is here alluded to only for the purpose of acknowledging a very handsome offer, which was made him by M. Le Verrier, on his becoming accidentally aware that the publication was temporarily at a stand, to provide for the immediate appearance of his Catalogue as a part of the next volume of the *Annales* of the Paris Observatory. The acceptance of M. Le Verrier's offer was rendered unnecessary by the actual decision of the Admiralty authorities.

His time being thus taken up in desk-work, no observations

have been made on the meridian beyond those necessary for rating the clock; but what was before his second subject of observations, the forms and positions of the solar spots, has during the past year been made the only one, and will for the present be pretty closely kept to. With the increasing activity of the sun, now very decidedly indicated, more time and labour is required. During the past year the sun was viewed on 227 days. Observations of spots, amounting in all to 449, were obtained on 167 of these days, blank disks being recorded on the remaining 60 days. The positions observed have all been reduced on the system previously adopted; and it is Mr. Carrington's intention forthwith to submit the four years' collection now obtained to a thorough examination. With what probable result it is impossible at present to guess in this hitherto baffling region of inquiry.

Since our last meeting, the Lords of the Admiralty have caused to be printed Mr. Carrington's *Redhill Catalogue of* 3735 *Circumpolar Stars*, a work which the Council cannot pass over without special notice.

The number of stars observed is sufficient evidence of the magnitude of the work; and when it is remembered that each star has been observed on the average four or five times, and that all lie within 9° of the North Pole of the heavens, every working astronomer will be able to form a pretty accurate idea of the amount of labour which must have been bestowed upon it.

The instrument employed was a transit-circle, which is in most respects, except its size, copied from that at Greenwich. The focal length of its telescope is $5\frac{1}{2}$ feet, and the aperture of its object-glass 5 inches. It is provided with two good collimating telescopes, which are used precisely as those of Greenwich. Ample proof is given of its general firmness and stability by the tables of instrumental errors which are prefixed, and especially in that element, which is all-important for observations of stars so near the Pole, namely, its azimuthal deviations. The flexure of its telescope has been carefully measured, and all minute corrections (excepting errors of division) have been taken into account with a fastidious accuracy, which we might almost pronounce to be unnecessary, but which is highly creditable. Greenwich places of the clock-stars are employed in the reductions, and some of the processes are copied, but not servilely, from the Greenwich Observations. Thus, the form of Bessel's Refraction Tables, used at Greenwich, is employed, but with an ingenious, and so far as is known, original modification, which renders the computation of refraction for the observations very easy indeed. For stars so near the Pole, special processes were required for the correction of precession, nutation, and aberration; and to this necessity we are indebted for a very elaborate investigation of the whole theory of the application of these corrections in cases where the small terms, usually neglected, must be taken into account.

In addition to the compilation of the Catalogue, Mr. Carrington has compared the resulting places with those of Professor Schwerd, who, with an instrument of less power, observed the same zone of the heavens about the year 1828, the number of stars compared being 679. This itself was a very laborious work, and is at the same time a very useful one.

Such a work as the *Redhill Catalogue of Stars* deserves a special acknowledgment from this Society, both from its rarity and its value.

The author not only built an observatory, and furnished it with excellent instruments, but he built a house to live in while he made the observations, and out of his private funds engaged an observer to assist him. Talent and zeal, untiring devotion and industry, and an unsparing but prudent application of private resources, have equally combined to produce the work in question. Mr. Carrington has brought to it all the analytical resources of the accomplished theoretical astronomer, he has used his own labour in observing as freely as that of any paid assistant, and has done the whole at his own expense. The work was a labour of love; and the results are such as might be expected,—of unquestioned excellence, and a standing memorial of his ability and love for science.

During the past year Mr. De La Rue has removed from Canonbury, London, to the village of Cranford, about twelve miles west of Hyde Park, and has there built an Observatory, the geographical position of which is, North latitude 51° 28′ 57″·8 and West longitude in time $1^m\ 37^s{\cdot}5$. The Observatory consists of a transit-room, containing a small transit-circle by Simms, and a clock by Condliffe of Liverpool, and of a circular equatoreal room, surmounted by a cylindrical revolving roof, 19 feet 6 inches in diameter, with a slit 3 feet 6 inches wide, in which is placed the Newtonian equatoreal, made in his own workshop, of 13 inches aperture and 10 feet focal length, formerly erected at Canonbury in the open air. In consequence of surrounding objects, it was necessary to elevate the equatoreal on a pier, 15 feet high. This circumstance has afforded an opportunity for the construction of a photographic laboratory immediately under the floor of the equatoreal room.

Mr. De La Rue is much pleased with his change of locality, as the reflector performs quite as well under the dome, with its very wide slit, as it did in the open air; and the atmosphere is not only clearer, but generally much steadier than at the old station at Canonbury, which had been much built around during the last few years; so that minute objects, such as the close satellites of *Saturn*, and even the finer details of the planet itself, can be made out more frequently and more satisfactorily at Cranford than at Canonbury. At the latter place, the equatoreal being in the open air, it was not thought expedient to provide it with a clock-work driver; but this has been added to it in

the new Observatory; and Mr. De La Rue has resumed his experiments in celestial photography, which he commenced in 1852, but which he relinquished, after having obtained a few good lunar photograms, in consequence of the difficulty of following the motion of the moon by hand.

The results of Mr. De La Rue's labours in this direction have been exhibited on several occasions to the Society, when the members had an opportunity of inspecting photograms of the moon, showing an amount of detail hardly to be expected when all disturbing influences are taken into account; and also photograms of *Jupiter*, *Saturn*, and of *Castor*, of great beauty and promise. Since the month of August the Observatory has been chiefly devoted to photography; and a large number of photograms of the moon have been obtained, which will be of great value in forming selenographic charts, and in showing correctly the extent and direction of the moon's libration. Several stereoscopic views of the moon have been obtained, by grouping together photograms of the moon, when in nearly the same phase, but in a different state of libration. These stereoscopic groups show the moon quite spherical, and give a true impression of the heights and depressions. Among other revelations, they prove that the radiating lines, which converge through *Tycho*, like parallels of longitude, are due to ridges and furrows, which are overlaid by the craters. It is quite wonderful to see how very readily two photograms, very different in diameter (in consequence of their being taken when the moon is at different distances), coalesce so as to produce a perfect stereoscopic view.

Mr. De La Rue has made several photographic comparisons of the relative photogenic power of the luminous rays of the moon, *Jupiter* and *Saturn*, which show that the light of *Jupiter*, in proportion to its illuminating power, contains more chemical rays than that of the moon; and that the light of *Saturn* is twelve times less chemically energetic than that of *Jupiter*. Although *Jupiter* is not above a third as bright as the moon, it gives photographic impressions nearly as rapidly as our satellite. Moreover, different portions of the moon's surface, equally bright to the eye, possess very dissimilar photogenic powers, thus clearly proving in the case of celestial objects (as in the case of terrestrial) that the chemical influence of their rays is independent in a certain degree of their luminosity. A very curious result, since to some extent confirmed by Professor Secchi, has been pointed out by Mr. De La Rue, namely, that those portions of the moon's surface, which are illumined by a very oblique ray from the sun, possess so little photogenic power, that, although to the eye they appear as bright as other portions of the moon illumined by a more direct ray, the latter will produce the effect, called by photographers, solarization, before the former (the obliquely illumined portions) can produce the faintest image. Mr. De La Rue has lately observed that these phenomena obtain to a greater extent in the vast plains usually designated seas than in the

mountainous districts about Tycho; and he inclines to the view that the moon is surrounded by a comparatively dense atmosphere of small extent, and that vegetation exists on the lunar surface, particularly in those portions generally called seas.

In the last Annual Report, attention was called to the circumstance that Photographs of Stars were still desiderata. Our *Monthly Notices* have since afforded evidence that the call has been responded to, and that the wish had only to be expressed to be gratified. Photographs of groups of many individuals have not yet been laid before us; but the beautiful images of a double-star (*ζ Ursæ Majoris*) sent over by our associate Mr. Bond, show that something more than the first step is taken, for the impressions are already of an excellence to bear minute microscopic measurement, and yield results of superior accuracy to the old method of observing. Another specimen, furnished also by our friends of the Harvard College Observatory, a photographic transit of *α Lyræ*, for the first time exhibited palpably to deliberate ocular inspection the little pulsations and irregularities of motion through the field, caused by the irregular action of the atmosphere, that limit to all our refinements of observation by the eye. Mr. De la Rue has, as is well known to the Fellows, also produced some results of high importance in improved images of the moon, bearing considerable magnification in copying, and some suitable for stereoscopic combination, but more particularly images of the planets *Jupiter* and *Saturn*, with some approach to physical detail. It is of importance to record in these annual retrospects the successive steps gained in this department, which wants only the investment of adequate capital and diligence to have a very prominent, if not revolutionary influence on the future of observing art. We had hoped to be able to report the Kew instrument for solar photographs in active operation, but we understand that Mr. Welsh's other duties are too onerous for him to work this instrument and battle through its difficulties at present, and that some further organization is required.

Professor Secchi, of Rome, has communicated to the Society, under the date of Rome, Jan. 31st, 1858, the following observations on Celestial Photography. He says that he is able to obtain lunar photograms in a very short time: at the last full moon a negative was obtained too strong in 20 seconds, and a sufficiently intense positive in a single second. Professor Secchi remarks that it appears to him that the collodion shrinks a little in drying, and distorts the microscopic features of the moon, hence that it is his intention to magnify the moon's image on the collodion by the interposition of an eye-piece, and that he has in a preliminary trial obtained a promising result in this way. In regard of the different degrees of photogenic power of the moon's surface, when directly or obliquely illuminated, Professor Secchi remarks that the time required to produce a picture is greatly different, accord-

ing to the different phases; an impression of the full moon can be obtained in 20 seconds, while an equally bright new moon requires from 5 to 6 minutes. Professor Secchi has also obtained a photogram of *Jupiter*, with his belts, "very nicely expressed," and states that he agrees with Mr. De la Rue that the light of this planet is, in comparison with its luminosity, more photogenic than that of the moon.

In allusion to Prof. Secchi's photograms of the moon, it is remarked, in a recent number of the *Cosmos*, "Now that it is demonstrated that the light of our satellite possesses in a high degree a photogenic power, it would appear that the influence which has been attributed to the lunar rays on vegetation, and in producing certain physical changes, can no longer be denied."

In a paper on the Solar Parallax, which recently appeared in the *Monthly Notices*, containing some valuable suggestions relative to the mode of determining that element by observations of the transits of *Venus* in 1874 and 1882, the Astronomer Royal has remarked that the same object may be effected by observing the displacement of *Mars* in right ascension, when he is far east of the meridian, and again when he is far west of the meridian, as seen at a single observatory. The advantages of this method are clearly pointed out by Mr. Airy, and he has further shown that the oppositions of 1860, 1862, and 1877, will be peculiarly favourable for determining the parallax of the planet by its application. With a view to this object he recommends that for each opposition a chart should be executed, containing an accurate delineation of all stars in the vicinity of the planet. Such a desideratum, it is not to be doubted, will duly emanate from some trustworthy source.

Colonel James has recently communicated to the Royal Society a paper, drawn up by Capt. Clarke, R.E., containing some interesting details, respecting the trigonometrical survey of the British Isles. In the course of the survey, several bases of from five to seven miles in length were measured; but the results mainly rest upon the Lough Foyle and Salisbury Plain bases, which were measured with General Colby's compensation-bars. The difference between the measured and computed lengths of the one base from the other through the triangulation, amounting to 0·4178 foot, was divided in proportion to the square root of the lengths of the measured bases, and thus a mean base was obtained which was used in the triangulation. It is worthy of remark that the differences between the measured and computed lengths of the earlier bases of the survey, measured with Ramsden's steel chain, are less than the corresponding differences of the Lough Foyle and Salisbury Plain bases. The longest meridional arc of the survey extends from Dunnose, in the Isle of Wight, to Saxavord, in Shetland. The amplitude of this arc is 10° 10′ 31″·43. Another arc extending from St. Agnes' lighthouse in the Scilly

Isles, to North Rona, has an amplitude of 9° 13′ 41″·25. An investigation of the figure of the earth, based upon the best modern arcs, gives $\frac{1}{298{\cdot}07}$ for the ellipticity. The ellipticity which best represents the surface of the British Isles is found to be $\frac{1}{299{\cdot}33}$. The former of these results agrees very satisfactorily with the values of the ellipticity obtained by Bessel and the Astronomer Royal.

The path of the central line of the approaching Eclipse of the Sun as not existing on any map with a precision such as could be obtained from Mr. Hind's recent publication, the Council thought it expedient, a few days ago, to suggest to Colonel James, R.E., the head of the Ordnance Survey, the desirableness of supplying this defect. Colonel James immediately replied that he had put the work in hand on receiving the application. A trustworthy map will, no doubt, be the speedy result of this prompt and willing acquiescence, for which the Society will feel grateful.*

The principle of "Rotatory Stability,"—or the constancy with which a heavy body revolving with great velocity about one of its principal axes, and in perfect equilibrium, its axis being free to take any position, retains its rotation in the plane in which it was at first impressed,—renders such a rotating body independent of all angular motion of bodies with which it is connected; a result of which the most striking exemplification has been given in the experiment of M. Foucault, demonstrating by this method the rotation of the earth; an experiment of which it now appears the first suggestion was made by Mr. Sang, of Edinburgh, so long ago as 1836. This principle has now received an important application to the purposes of nautical astronomy from Prof. C. P. Smyth. To procure *stability* for the purposes of astronomical observation on board ship, it seemed at first an obvious resource simply to employ free suspension from a fixed support. In such a case there is, indeed, a *semblance* of steadiness, in that, for example, articles on a table so suspended keep their places, and a vessel of water does not spill. But this is merely a case of the same kind as the retention of water in a cup by centrifugal force when whirled over the head. The surface keeps perpendicular to the string, not parallel to the horizon. But in these cases the body suspended is like a plumb-line, when the point of suspension is itself put in motion, it then acquires a part of that motion and becomes a pendulum. Thus on board ship every fresh motion of the vessel adds to the oscillatory movements.

Nairne's or Irwin's marine chair, for telescopic observations at sea, was thus suspended, and practically found to fail, though the cause of its failure was not understood till it was explained on the above principle by Sir J. Herschel. (*Admiralty Manual of Instructions*, &c.) In like manner, for observation of altitudes by

* The Astronomer Royal has since the meeting kindly drawn up a few suggestions for observing the eclipse, which will be found at page 129.

reflexion, Troughton's "top," or spinning reflector, was found to fail; and its failure is primarily due to the same cause, viz. that the centre of gravity being *below* the point of support, when not rotating it acquired oscillatory motion. But when spinning, this motion did not show itself *directly*, but was *compounded* with the rotation, and thus manifested in a *precessional* motion, or slow change of *plane* fatal to its use as an artificial horizon.

To afford a perfectly stable plane, whether for an artificial horizon, or for supporting a telescope uninfluenced by the motions of the ship, Prof. C. P. Smyth availed himself of the principle of "rotatory stability," by adapting to his purpose the gyroscope, or free revolver, mounted in gymbals, and accurately balanced, so that its centre of gravity coincided precisely with the centre of motion.

The compound angular motion of a ship is resolvable into motions in three co-ordinates, (1) vertical in the plane of the keel; (2) vertical in the plane at right angles, of the beam; (3) horizontal: or, in nautical language, pitching, rolling, and yawing respectively.

The revolver resists all angular motion *perpendicular* to its own plane; but offers none to motion *in* that plane.

Thus one revolver spinning with its disk horizontal combined with another in the same exterior frame having its disk vertical, will give a plane exempt from angular motion in each of the three planes. An artificial horizon, or a telescope, mounted on such a frame, and the whole perfectly balanced, will thus possess the much-desired quality of perfect *relative* stability, or *parallelism*, under all the motions of the ship.

The same apparatus, enlarged in scale merely, might carry the observer as well as the telescope. But here it would be practically impossible to preserve the same accurate balance, and even the slightest motion of the observer would be communicated to the apparatus, and produce a *precessional* motion. This Prof. C. P. Smyth proposes to remedy, by simply arranging two revolvers in a common exterior frame, and having their internal pivots placed at right angles to each other, so that angular motion *about the pivots* of one, would affect *only the other* with a precessional tendency; and reinforcing each with another revolver in a similar position, a balanced frame is produced with two opposite pairs of revolvers, with axes at right angles, in the *horizontal* plane, combined (as before) with a fifth in the middle in a *vertical* plane, by which both the angular motions of the *ship*, and those produced by the *observer*, are overcome.

Of the subsidiary contrivances, the application of the driving wheelwork, to communicate an immense velocity to the revolvers, is one of the most important, and Prof. C. P. Smyth proposes to use water power applied by a peculiarly ingenious form of the *turbine*.

Another subsidiary matter is the introduction of a new artificial horizon to be placed upon the stable platform for use with

the sextant. This consists essentially of a spirit level, the tube being bent into an arc of a circle, and the minute bubble being seen by a diagonal reflector, and placed at an infinite distance by a collimating lens, whose principal focal length is equal to the radius of the bent tube, gives the true horizontal point with which the sun or star is to be brought into contact.

So far as the simple free revolver and the artificial horizon are concerned, the principle was most successfully put to trial in practice in Prof. C. P. Smyth's voyage to Teneriffe, in Mr. Stephenson's yacht Titania, in 1856. The apparatus having been exhibited in the Paris Exposition, 1855, and the whole more fully described in communications to the Royal Scottish Society of Arts, and the Royal Astronomical Society, in the course of 1857.

The Council feel assured that the Society have received with high satisfaction the announcement of the recent publication of Professor Hansen's Lunar Tables. The elements upon which these important tables are founded were determined by a discussion of the best modern observations of the moon, except the mean motions, the values of which were found by a comparison of the modern with the ancient observations. It is, no doubt, generally known that the expressions for the moon's co-ordinates, upon which the inequalities of the tables depend, have been derived from a new theory of perturbation which is due to Professor Hansen, and which consists in throwing the effect of the perturbation in longitude upon the mean anomaly. In the construction of these tables Professor Hansen has also taken into account the effect which would be produced by a displacement of the moon's centre of gravity with respect to her centre of figure. An investigation of this subject, which adorns the *Memoirs* of the Society, had already indicated to him the amount of this displacement. The inequalities in the expression for each co-ordinate are skilfully grouped together by a peculiar process, and arranged in tables, partly of single and partly of double entry. The tabular values of the arguments are expressed in time, and the arrangements in other respects are very conveniently adapted to the computation of an ephemeris of the moon's place. Professor Hansen, in a letter to the Astronomer Royal, which was published a few years since in the *Monthly Notices*, has shown that a remarkably close accordance exists between the results of these tables and the observations of the moon made at Greenwich, both in Bradley's time and in the present century. The values of the secular inequalities have been satisfactorily tested by the Astronomer Royal, on the occasion of his researches connected with the ancient eclipses of Thales, Agathocles, and Larissa. The Council cannot omit this occasion of expressing the high opinion which they entertain of the value of Professor Hansen's labours in the construction of these tables; and they naturally look forward with much interest to the publication of the theory on which they are founded, and which, it is understood, will shortly be given to the world.

Ten new members of the group of minor planets have been added to the solar system since our last anniversary. The first, *Ariadne*, was discovered by Mr. Pogson at Oxford, on the 15th of April; the second, *Nysa*, was discovered by M. Goldschmidt at Paris, on the 27th of May; the third, *Eugenia*, was discovered also by M. Goldschmidt on the 28th of June; the fourth, *Hestia*, was discovered by Mr. Pogson at his private residence, Oxford, on the 16th of August; the fifth, *Aglaia*, was discovered on the 15th of September by Dr. Luther, at the Bilk Observatory; the sixth, *Doris*, and seventh, *Pales*, were both discovered by M. Goldschmidt on the same evening, namely, the 19th of September. The eighth, *Virginia*, was discovered on the 4th of October by Mr. Ferguson, at the Observatory at Washington, and also independently by Dr. Luther at the Bilk Observatory, on the 19th of the same month; the ninth, *Nemausa*, was discovered by M. Laurent at Marseilles, on the 22d of January of the present year; the tenth was discovered on the 6th of February by M. Goldschmidt, at Paris. The aggregate number of minor planets now amounts to fifty-two.

The Council regret to notice that very little has been done during the year, in this country, in the computation of the orbits of the many new members of the solar system discovered since our last anniversary. With the number of willing heads and hands, which this Society alone boast of, it is to be hoped that we are not on all occasions to have to thank our foreign friends for the particulars which interest all alike. Of the last six members of the asteroid group, elements are still wanting altogether in one case, and are but rough approximations in the remainder. Is it possible that a feeling of want of novelty has arisen, or have our energetic explorers fairly outsailed their brethren of the pen and logarithms ?

Eight comets have been discovered since the last anniversary of the Society. Of these, seven were discovered in the course of the past year, and one since the commencement of the current year.

The first comet of the year 1857 was discovered on the 22d of February, by Professor D'Arrest at Leipsic. It was also discovered independently by Van Arsdale at Newark, U. S. It continued during the period of its visibility to exhibit a faint telescopic aspect. The elements of the orbit were found to be sensibly parabolic.

The second comet of 1857 was discovered by Dr. Bruhns, at the Berlin Observatory on the 18th of March. It was speedily found by the German astronomers that this was no other than a rediscovery of Brorsen's comet which was originally discovered in 1846, and was ascertained to revolve in an elliptic orbit with a period of somewhat less than six years, but which no astronomer had succeeded in detecting on the occasion of its next return to

the perihelion in the year 1851. A Dutch astronomer, Van Galen, had calculated its motion for the next period, and found that its passage of the perihelion would take place on the 29th of June. The perihelion passage occurred in reality on the 25th of March. The discordance arose from Van Galen having assumed the mean motion to be a little too small. In other respects his calculations were found to be very accurate. The period of revolution is about 2026 days.

The third comet of the same year was discovered on the 22d of June at Göttingen, by Dr. Klinkerfues. No trace of ellipticity was discoverable in the orbit.

The fourth comet was discovered by Dr. C. H. F. Peters, on the 25th of July at the Dudley Observatory, Albany, U. S. It was also discovered independently in Europe, by M. Dien at the Imperial Observatory of Paris, and by Professor Habicht at Gotha. It was a faint telescopic object without any visible nucleus. Mr. Watson, Assistant at the Observatory of Ann Arbor, Michigan, U. S., found that the observations would be best satisfied by an elliptic orbit, the major axis of which indicated a period of 258 years. This result appears to be confirmed by a subsequent investigation of M. Pape, assistant at the Observatory of Altona.

The fifth comet was discovered by Dr. Klinkerfues at Göttingen, on the 20th of August. A parabolic orbit was found to satisfy the observations.

The sixth comet was discovered by Dr. Donati at Florence, on the 10th of November; it was also discovered independently on the same evening by Van Arsdale at Newark, U. S. The orbit was found to be sensibly parabolic.

The seventh comet of 1857 is D'Arrest's comet of about 6·4 years' period, which appears to have been discovered about the close of the year at the Royal Observatory, Cape of Good Hope. The only information which the Council at present possesses relative to this interesting body is derived from a letter addressed by Mr. Maclear to the Astronomer Royal, dated 1857, Dec. 26, in which it is stated simply that the comet had been discovered and was being observed with the 8½-foot equatoreal.

The first comet of 1858 was discovered on the 4th of January, by Mr. Tuttle at Cambridge, U. S., and also independently on the 11th of the same month, by Dr. Bruhns at Berlin. The elements of its orbit have been found to bear a strong resemblance to those of the second comet of 1790. This would indicate a period of sixty-eight years, but it may not improbably have returned to its perihelion more than once since its apparition in 1790; and in fact, from an investigation of the elliptical elements, it would seem to revolve in a period of about thirteen years.

The comet of Faye will be due again in August 1858, that of Encke in November 1858, and that of Biela in April 1859.

The attention of cometary astronomers will doubtless be directed to furnishing information on these points.

The question of the identity of the comets of 1276 and 1556 has recently formed the subject of an investigation by M. Hoek, of the Observatory of Leyden. M. Hoek is of opinion that the orbit of the comet of 1556 has been determined with tolerable precision, but that the orbit of the comet of 1276 is liable to much uncertainty, the calculation of the elements being mainly based upon Chinese observations. He maintains that the discordance between the orbits of the two comets is too great to be accounted for either by the errors of the observations or the effects of planetary perturbation; and, consequently, he infers that the two apparitions cannot refer to the same body.

Papers read before the Society from February 1857 *to February* 1858.

1857.

Mar. 13. On Archdeacon Pratt's Figure of the Indian Meridian. Lieut. Tennant.
Observations of Minor Planets. The Astronomer Royal.
On an Annular Eclipse. M. Hansen.
Occultation of *Jupiter*, Oct. 12, 1856. Capt. Jacob.
Do. do. Jan. 2, 1857. Mr. Simms.
On Finding the Latitude with the Theodolite. M. Babinet.
Supplement to Solar Tables. M. Hansen.
On an Artificial Horizon. Mr. Taylor.
Occultation of *Jupiter*, Jan. 2, 1857. Rev. Prof. Challis.
Observations of *Saturn*. Lord Wrottesley.
On Variable Stars. M. Argelander.
Numerical Solution of Kepler's Problem. M. De Gasparis.
Elements of D'Arrest's Comet. Mr. Martin.
Occultation of 27 *Arietis*. Rev. W. R. Dawes.
Occultation of *Jupiter*, Jan. 2. Mr. May.
Observations of Minor Planets. The Astronomer Royal.
On Optical Phenomena in Occultations. Rev. B. Powell.
On two Ancient Eclipses. Dr. Stroud.
Projection of Stars on the Moon. Mr. Lassell.

April 8. Observations of the Satellites of *Uranus*. Mr. Lassell.
Do. of *α Centauri* and *Saturn*. Capt. Jacob.
On the Theory of Comets. Mr. Legh.
On the Constant of Refraction. Rev. R. Main.
Sextant Observations. Mr. W. Simms.

May 8. Observations of Minor Planets. The Astronomer Royal.
Projection of *Spica Virginis*. Mr. Chalmers.
Passage of D'Arrest's Comet over a Fixed Star. Mr. Hodgson.
On Variable Stars. The Astronomer Royal.
Additional Note on Solar Eclipse, Sept. 1857. Lieut. Tennant.
Observations of Comet II. 1857. Mr. Hartnup.
Do. of Pogson's Planet. Do.
Do. do. The Astronomer Royal.

May 8. Experiences with a Free Revolving Stand. Prof. C. P. Smyth.
Observations of Comets and Pogson's Planet. Rev. Prof. Challis.
Do. of Comet II. 1857. Dr. Donati.
On the Limit of the Photographic Power of the Sun's Rays. Mr. Waterston.
Observations of *Mars*. Sig. Secchi.
On the Variable Star 420 *Mayer*. Mr. Hind.
Occultation of *Spica Virginis*. Mr. Burr.
On the Variable Star *u Geminorum*. Mr. Pogson.
Note accompanying Drawings of *Jupiter*, &c. Sig. Secchi.

June 12. Observations of Minor Planets. The Astronomer Royal.
Letter to Admiral Manners. M. D'Abbadie.
On Stellar Photography. Mr. Bond.
Observations of Stars in the Nebula of *Orion*. M. O. Struve.
Observations of *Ariadne*. Mr. Pogson.
On the Zodiacal Light. Prof. C. P. Smyth.
Occultation of *Spica Virginis*. Mr. Huggins.
Note to the Astronomer Royal. Mr. Johnson.
On the Nature of Visible Magnitude. Mr. Harpur.
On the Effect of Local Attraction on the Figure of the Earth. Lieut. Tennant.
On Finding the Focal Length of Convex Lenses. Rev. T. Webb.
Abstract of Lecture on three Ancient Eclipses. The Astronomer Royal.
Note on R *Leonis*. Mr. Baxendell.
Occultation of 58 *Virginis*. Capt. Noble.
On the Zodiacal Light. Lieut. Hardy.

July 10. On Stars in the Trapezium of *Orion*. M. D'Abbadie.
On a Mode of Determining the Distance of a Planet from the Sun. M. De Gasparis.
Observations of *Saturn* and his Satellites. Mr. Lassell.
New Double Stars discovered by Mr. R. Clarke. Rev. W. R. Dawes.
On the Variability of 30 *Herculis*. Mr. Baxendell.

On the Application of the Formula of Precession in the State of Stars near the Pole. Mr. Carrington.
Astronomical Photography. Mr. W. C. Bond.
On the Construction of an Altimeter. Mr. Colby.
On a Phenomenon seen at Bath. Lieut. Hardy.
Do. do. Archdeacon Burrow.

Nov. 13. Observations of Total Solar Eclipse, March 26, 1857. Mr. Clarke.
Observations of Stars in the Nebula of *Orion*. M. Secchi.
Do. of Comet II. 1857. Dr. Donati.
Abstract of Results of Measurements of *Saturn's* Satellites. Capt. Jacob.
On the Eclipses of Agathocles, Larissa, and Thales. The Astronomer Royal.
Observations of Comet IV. 1857. M. Trettenero.
Discovery of Comet V. 1857. Dr. Peters.
Discovery of two New Planets. M. Goldschmidt.
Micrometrical Measurements of γ *Virginis*. Admiral Smyth.
Occultation of *Mars* by the Moon. Mr. Prince.
Remarks on Scintillation. M. Delfour.
Occultation of *Mars* by the Moon. Capt. Noble.
On the Appearance of Round Bright Spots on one of the Belts of *Jupiter*. Rev. W. R. Dawes.
On the Measurements of the Position Angles of Double Stars with the Double-image Micrometer. Rev. W. R. Dawes.
Places of Small Planets observed at Greenwich. The Astronomer Royal.
Observations of *Hestia*. Mr. Pogson.
Results of Measures of γ *Virginis*. Mr. Baxendell.
Occultation of *Mars*. Mr. Burr.
Announcement of Ferguson's New Planet. Lieut. Maury.
Observations of *Victoria*. Mr. Pogson.

Dec. 11. Magnitudes of Forty of the Minor Planets. Mr. Pogson.
Occultation of the *Pleiades*, Mass of *Jupiter*, &c. Capt. Jacob.
Results of Experiments with a new Refractor. Sir W. K. Murray.
Further Observations of Bright Spots on *Jupiter*. Rev. W. R. Dawes.
On Bright Spots on one of the Belts of *Jupiter*. Sir W. K. Murray.
On Mr. Bond's Application of Photography to Astronomy. Mr. Airy.
On a Proposed New Telescope by Mr. Lassell. Mr. Airy.
On Stellar Photography. Mr. De La Rue.
General Form of Coefficients in the Development of the Perturbatial Function. Mr. Cayley.

1858.

Jan. 8. On Celestial Photography. Mr. De La Rue.
Observations of Small Planets. The Astronomer Royal.
On Hind's Coloured Star in *Lepus*. Mr. Lettsom.
Improvements in Double-image Micrometers. Mr. W. Simms, Jun.
On his New Artificial Horizon. Prof. C. P. Smyth.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

Her Majesty's Government.
Royal Society of London.
Royal Society of Edinburgh.
Royal Geographical Society.
Royal Institution.
Royal Dublin Society.
Geological Society.
Linnean Society.
Photographic Society.
Philological Society.
Zoological Society.
Cambridge Philosophical Society.
Society of Arts.
Philosophical Society, Manchester.
Historic Society of Lancashire.
Art-Union of London.
British Association.
Institute of Actuaries.
Hon. East India Company.
The Lords Commissioners of the Admiralty.
The Registrar-General.
The Radcliffe Trustees.
Royal Observatory, Edinburgh.
L'Académie Impériale des Sciences de l'Institut de France.
Le Dépôt Général de la Marine.
L'Académie des Sciences de Dijon.
The Society at Cherbourg.
Imperial Academy of Vienna.
Imperial Observatory of Vienna.
Royal Observatory of Munich.
Royal Academy of Berlin.
Royal Academy of Brussels.
Royal Society of Göttingen.
Royal Academy of Sciences, Madrid.
Royal Observatory, Königsburg.
American Government.

American Academy of Sciences.
American Philosophical Society.
Franklin Institute.
Smithsonian Institution.
Observatory at Harvard College.
Observatory at San Fernando.
The Editor of the Athenæum Journal.
The Editor of the Literary Gazette.
The Editor of the Critic.
The Editor of the Civil Engineers and Architects' Journal.

G. B. Airy, Esq.
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R. Taylor, Esq.
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Rev. Dr. Whewell.
Mr. J. Williams.
Dr. R. Wolf.
Dr. B. Zuckermann.

Address delivered by the President, M. J. Johnson, Esq., on presenting the Medal of the Society to Mr. Main :—

Gentlemen,—In the absence of your President, the Council has done me the honour of placing me in this Chair—an honour I fully appreciate, though I wish they had selected a worthier representative of a man who for thirty years has been a most devoted and efficient officer of our Society, a most munificent supporter of our science, and who is associated with many of us by the closer ties of personal friendship and regard.

You will share in my feelings of sincere regret that we are

deprived of an opportunity of greeting him in this place; and I regret his absence more especially on this occasion, because I am sure it would have been most gratifying to him to have been the channel of conveying to an esteemed colleague a tribute which the unanimous voice of your Council has conferred upon him.

You all know, Gentlemen, that for many years past Mr. Main has been one of the most frequent contributors to our *Memoirs*. His papers relate to a variety of subjects, all requiring much knowledge, skill, and labour in their treatment. Viewed as a series of unconnected memoirs, many of them are very remarkable productions. But they acquire greater importance when we take into consideration the object the author had in view,—which was to deduce from the observations of the Royal Observatory certain special results to which the circumstances of the day, or the inherent importance of the subject, gave an interest.

You know the wide scope of the Greenwich Observations—you know the order and exactness which pervade every part of that work; how rigorously the observations are discussed—how methodically they are arranged—how carefully the planetary observations are compared with the best tables. More than this is not attempted.

To discuss the bearing of the results obtained, in reference to special theories—to enter upon detailed comparisons with older observations—to investigate the sources of tabular errors, form no part of the plan, and, in my humble opinion, very wisely. Such a course would not only endanger the regularity of publication, one of the most important and striking features of the Establishment, but its resources, instead of ministering to the general wants of astronomy, might at any time be diverted to carrying out the particular views of an individual.

Nevertheless, though not the appropriate task of the Establishment itself, it is obviously of the highest importance that investigations, such as those I have mentioned, should be made; and that astronomers should be informed, in relation to the current topics of the day, what are the special results obtained in one of the best equipped and most ably conducted observatories the world has ever seen.

Fortunately, this conviction seems to have forced itself on Mr. Main very soon after his connexion with the Royal Observatory; and, accordingly, you will find that—with two exceptions, to which I will advert presently—he has kept this object steadily in view, in all his communications to the Society.

1. We have three memoirs from him on the elements of the planet *Venus*, the first of which was read as long ago as the year 1837. This discussion was based on three years' observations at Cambridge, and those made at the Royal Observatory in 1836.

I ought to mention that the foregoing contributions called forth two other very valuable memoirs on the same subject. One by Mr. Glaisher, who discussed the observations made at Greenwich in 1837 and 1838. The other by Mr. Breen, whose investi-

gation was founded on the observations between 1750 and 1830, which appeared in the Greenwich Planetary Reductions. These several memoirs cannot fail to be of great service to the future investigator of the motions of *Venus*.

2. Mr. Main has contributed two papers on the form and dimensions of the planet *Saturn*.

The first memoir has especial reference to the figure of the planet itself, which Sir William Herschel conceived was irregular, resembling "a parallelogram with its corners rounded off." To test this statement, Mr. Main took the opportunity of instituting a very careful series of measurements in 1848, when the ring was invisible, by which he showed that Sir William had been mistaken. Bessel had arrived at the same conclusion, from measurements made with his heliometer in 1832, at which time the ring was about to disappear.

The object of Mr. Main's second communication on this subject was to show, from a rigorous examination he had made with the double-object micrometer, that Otto Struve's hypothesis of the gradual approximation of the interior border of the inner bright ring to the body of the planet, was untenable.

Another paper, which may be considered complementary to the above, treats of the diameters of the planets generally; and is, as far as I know, the completest discussion of the kind that we possess.

3. On sidereal astronomy we have from our author a very important and laborious contribution on the Proper Motion of 1170 stars deduced from comparison of their places in the Greenwich 12-year, with the Bessel-Bradley Catalogue.

This memoir, in my opinion, has not received its due share of notice; and had it emanated from any but a professional astronomer, I believe it would long ago have received, for its own sake, the tribute we are about to concede to Mr. Main's accumulated labours.

Excepting the British Association Catalogue, I know of no undertaking of the kind of equal magnitude, and in point of accuracy I believe Mr. Main will be found to deserve the preference.

Conceiving that the time has arrived when a proper motion of the solar system ought to be admitted among the established facts of astronomy, and that probably we are on the eve of arriving at an approximate estimate of its amount, Mr. Main has calculated for 105 stars,—whose proper motions in right ascension and north polar distance, amount to $0''{\cdot}3$ of a great circle,—the factors of solar motion in both co-ordinates, assuming the direction of motion to be towards the point in the heavens whose R.A. $= 260°$, and N.P.D. $55°\ 37'$. Thus, the amount of solar motion being known, its effect on the displacement of the apparent place of a star may be separated from the displacement arising from the star's own motion.

This addition, I need not remind you, increased very much the computational labour of the communication we are considering.

In fact, with comparatively little more exertion, Mr. Main might have furnished another independent determination of the direction in which our system is moving; and I believe his only reason for not doing so was, that he considered the labours of Argelander, Otto Struve, Lundahl, and my lamented friend, Thomas Galloway, had, for the present, definitively settled the question.

The paper on the Constants of Aberration, Nutation, and Parallax from observations of γ *Draconis* with the 25-foot zenith tube, is another most laborious production, as you may judge from the fact that besides the computation of the several coefficients, the results involved the solution of 161 equations of condition containing four unknown quantities.

The result was unsuccessful, inasmuch as it gave a large *minus* parallax. Still the paper is a valuable addition to our *Memoirs*, and perhaps it would be well if we had more such candid expositions of failure. Many an astronomer would have been spared disappointment and expense.

The last contribution from Mr. Main's pen, which I have to consider, is a most elaborate discussion of Bessel's constant of refraction founded on the Greenwich Observations from 1836 to 1854.

In the practical treatment of this problem it has been the custom to use results obtained at one observatory only; and this, perhaps, is the most rigorously correct course; but it is liable to the objection that circumpolar stars only are available, and consequently the lower observations must be made all on one side of the zenith. In order to take advantage of the numerous observations made at Greenwich, of stars which culminate near the south horizon, Mr. Main has pressed into his service the determinations of Henderson and Maclear of the same stars at the Cape of Good Hope where they pass very near the zenith. The observations at the latter station having been reduced by exactly the same elements as those at Greenwich.

In adopting this process, of course, we must assume that the constant of refraction is not affected by locality, that it is the same at the Cape as it is at Greenwich. That it is so I think there cannot be a doubt after Henderson's scrupulous examination of the Cape constant, which he found to be almost identical with Bessel's.

But there was this difficulty to be encountered. In the values of mean refraction given in the *Tabulæ Regiomontanæ*, the law which obtains *below* 85° of zenith distance, is not the same as that which obtains *above* that limit. In fact below 85° Bessel's values may be almost said to be empirical. But as many of the stars common to the Cape and Greenwich, as well as many circumpolar stars observed at the latter place, culminate *below* 85°, the results deduced from them were clearly incommensurable with those which culminate *above* 85°. To escape this difficulty, Mr. Main had recourse to an artifice which cost him a great deal of trouble.

As far as 85° of zenith distance, the table of refractions in *Fundamenta Astronomiæ* and in the *Tabulæ Regiomontanæ*, is

essentially the same, the only difference being that the values in the latter are slightly increased. But in the *Fundamenta* no change of law takes place at 85°. Taking advantage of this circumstance, Mr. Main referred all his results to the *Fundamenta*, and then determined the difference between the two tables, and thus obtained a series of strictly comparable results.

Perhaps it may be questioned whether it would not have been better to have confined the primary examination to stars above 85°, and to have determined the errors below that limit in some other way. Be this, however, as it may, the investigation is very important as showing incontestably that we possess in Bessel's tables, as far as 82°, a means of obtaining consistent results at Stations separated by 90° of latitude. I do not think that this has ever been so clearly exhibited before. As far as 82° of zenith distance, Mr. Main recommends the continuance of Bessel's numbers in the *Tabulæ Regiomontanæ*. From 82° to 85°, he suggests a diminution of the tabular value. Below 85° he adopts the values in the *Fundamenta* also diminished in a given ratio.

I may add that Henderson's observations at the Cape also showed that Bessel's refractions at low altitudes were too great.

Thus I have endeavoured, very imperfectly, to point out to you the nature and extent of Mr. Main's exertions, and how completely they have been directed to the development of the Greenwich Observations, in a way which, consistently with its general duties, the Observatory could not attempt to pursue in its own publications. While as astronomers we rejoice that this important task has been performed by one who is in every respect fully qualified for it, we cannot, at the same time, fail to admire the energy and public spirit which has actuated its performance amidst duties which to most men would of themselves appear sufficiently onerous.

The two papers of Mr. Main I have alluded to, which have no relation to the foregoing design, are

1. That on the Annual Parallax, which contains the best exposition extant of the recent investigations of that subject. It was originally drawn up in the form of a report to the Council on the occasion of the vote of the Medal to Bessel, without any view to publication; but the Council esteemed it so highly that they requested it might appear in the *Memoirs*.

2. The paper on the Reduction of Sextant Observations of the great comet of 1843, which originated in a suggestion to the Council, from Mr. Main himself, to devote a small sum of money to the reduction of some observations made at sea, which appeared to deserve notice. In this, and in one of his papers on the orbit of *Venus*, only, has Mr. Main derived any public assistance in computation.

The President then delivering the Medal to Mr. Main, addressed him in the following terms:—

Mr. Main,—I have great pleasure in presenting you this

Medal, which you will accept as the highest acknowledgment it is in our power to make of your exertions in the cause of Astronomy. May your health be long spared, and may the Society long continue to receive the benefit of those talents which you have hitherto devoted to its service with so much zeal and disinterestedness.

The Meeting then proceeded to the election of the Officers and Council for the ensuing year, when the following Fellows were elected:—

President:

George Bishop, Esq. F.R.S.

Vice-Presidents:

G. B. Airy, Esq. M.A. F.R.S. Astronomer Royal.
Augustus De Morgan, Esq.
Manuel J. Johnson, Esq., M.A. F.R.S. Radcliffe Observer.
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ANNULAR ECLIPSE OF THE SUN, 1858, MARCH 14–15.

THE following suggestions for observation of the eclipse are not offered as by any means complete, but as presenting grounds for consideration, which may tend to direct observers in deciding on the employment of the means which they may possess.

I. *Observations not requiring Instruments.*

1. As the eclipse advances, it is desirable to obtain some notion or measure of the degree of darkness.

2. At what distance from the eye can a book or paper, exhibiting type of different sizes, be read?

3. Hold up a lighted candle nearly between the sun and your eye. At how many sun-breadths' distance from the sun can the flame be seen?

4. If you are in an elevated position, remark the changes of colour and appearance of the surrounding objects in the landscape.

5. If you see the spots of light formed by the intersecting shadows of the boughs of trees, remark whether they exhibit the lune-form of the sun.

6. When the annulus is formed, you will probably observe it with a darkened glass; but you are particularly requested to devote one instant (as early as possible) to the verification of this point, viz.: When the annular sun is viewed with the naked eye, does it appear an annulus or a fully illuminated disk?

II. *Optical, Astronomical, and Solar-physical Observations, requiring the use of Instruments.*

7. As the eclipse advances, estimate (on the image seen in the telescope) the comparative intensity of the sun's light near the centre of his disk and near his limb.

8. For the more critical observations, it is desirable that the power of your telescope should be so low as to give you an easy view of the whole breadth of the sun.

9. Remark irregularities on the moon's limb.

10. As the cusps become very sharp, remark whether they are irregular. For this, and for all the observations near the annular phase, it is necessary that you be provided either with a graduated prismatic shade, or with a succession of shades of different intensity, and that you instantly select the shade which is most agreeable to your eye.

11. Remark whether the sun's light extends beyond the inter-

section of the limbs of sun and moon, so as to make the moon's limb visible beyond that intersection. For this purpose the bright parts of the sun must be put out of the field of view, and the shade must be withdrawn.

12. As the annularity approaches and is formed, remark whether Baily's beads and strings are formed; whether first formed at points corresponding to large inequalities of the moon's limb; whether they surround the moon; how they form and break. Only an instant can be given to this observation. It is of the utmost importance to be assured that your vision at the instants immediately preceding, especially of the moon's inequalities, is very distinct.

13. Remark, as one of the most important observations of the eclipse, whether any red flames are seen on the sun's limb. For this purpose you must withdraw the shade, if you are on the annular track, the instant after formation of the annulus; if you are not on the annular track, as soon as the eye can bear the sun. On the annular track the whole line must be rapidly scrutinized; and when the ring breaks, the still-illuminated part must be put out of the field, and the moon's dark limb must be surveyed. At places not on the annular track, this plan (namely, to exclude the illuminated portion of the disk from the field, and to survey the moon's dark limb) must be followed throughout. It seems not improbable that the best chance of seeing red flames will be obtained at places not on the annular track.

14. At the breaking up of the annulus, look for Baily's beads as before.

15. Do not attempt any record during or near the annularity. Endeavour to impress observations on your memory as well as you can. If you have an assistant seated at a table with a chronometer and writing-materials, you may give him signals for the register of time, but you must connect the phænomena with the time afterwards.

16. A good sextant-observer may obtain valuable observations for correction of the lunar tables, by measuring the intervals between the points of the bright cusps. The observations will require great nerve, and will be difficult, but where most difficult they will be most valuable.

17. It seems doubtful whether any valid photographic record can be made, on account of the extreme rapidity of the change of appearances. Thus, in the neighbourhood of London, the line of cusps will change from the vertical to the horizontal position in about three minutes of time.

18. If you have a doubly refracting prism, it will be desirable to make observations on the polarization of the light from the sun's limb. For this purpose, when the lune is narrow, place the prism so as to separate the two images transversely to the limb, and remark which image is brighter. Turn the prism 180° round the visual ray, and repeat the observation. Remark carefully the positions of the prism. The prism may be used with the naked eye

or with the telescope, according to the amount of its angular separation of images.

III. *Meteorological Observations.*

19. For change in intensity of solar radiation, observations with the actinometer or the black-bulb thermometer should be kept up during the eclipse. The latter are most trustworthy when the bulb is inclosed in an exhausted glass sphere.

20. The barometer should be repeatedly observed.

21. The thermometer should be frequently observed, and the general feelings of cold should be noted.

22. Observations of humidity are very important. They should be made by the use, either of Daniell's dew-point instrument, or of the wet-bulb thermometer.

G. B. Airy.

1858, *March* 8.

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